Mem. Nat. Mus. Vict., 14, 1944.

THE CRANBOURNE METEORITES.

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Plate IV.

The object of this paper is to describe the four Cranbourne iron meteorites found in 1923, and to co-ordinate published records concerning them and the earlier found Cranbourne meteorites. The Cranbourne meteorites, including the four described here, comprise a group of ten closely related irons exceeding 10 tons in weight that appear to have been derived from the breaking up during flight of a single large mass of iron when close to the earth's surface. This view was proposed by Walcott (1915), who showed that the sites of the five irons then known lay along a straight line trending S. 30° W. from Beaconsfield to Langwarrin. His conclusion is greatly strengthened by the fact that the sites of the four Cranbourne irons found in 1923 and the Pakenham iron (Edwards and Baker, 1941) found in 1928 conform closely to this line.

The Cranbourne Irons

Five of the iron meteorites were found prior to 1886. Four more were found in 1923, and one in 1928.

The first to be found, the famous Cranbourne No. 1, was discovered in 1854 on the Carnmallam Pre-emptive Right, in allotment 39, parish of Sherwood, $3\frac{1}{2}$ miles south of Cranbourne township (Fig. 1). It weighed 3·5 tons, and is the largest meteorite to have been found in Australia. Its discovery evoked world-wide interest, and about sixty papers have been published concerning it and the other four of the group found prior to 1923, namely, the Cranbourne No. 2, Cranbourne No. 3, the Beaconsfield and the Langwarrin irons. Lists of the publications are given by Walcott (1915) and by Hodge Smith (1939). The Cranbourne No. 1 is now in the British Museum.

The Cranbourne No. 2 iron, which weighed 1·5 tons, was found in the same year as the Cranbourne No. 1. It is the second largest of the Cranbourne irons, being 37 in. x 32 in. x 21 in. It was found in allotment 39, parish of Cranbourne, 2 miles east of Cranbourne township (Fig. 1), and is now in the National Museum, Melbourne.

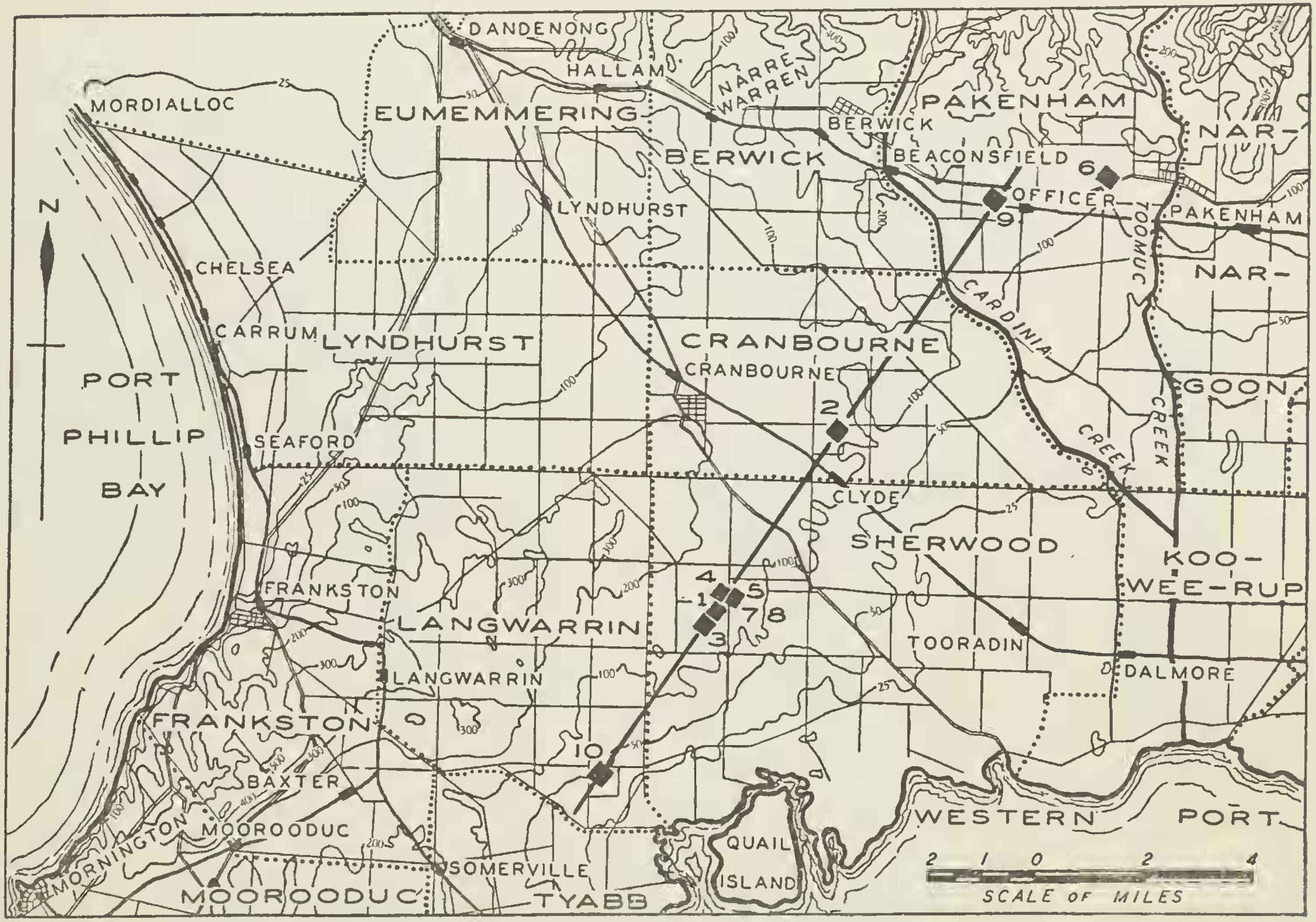

FIG. 1.

Sites of the Cranbourne group of Iron Meteorites. Compiled from the Lands and Survey county map of Mornington, 1919. Meteorite sites are indicated by full squares.

1, Cranbourne No. 1; 2, Cranbourne No. 2; 3, Cranbourne No. 3; 4, Cranbourne No. 4; 5, Cranbourne No. 5; 6, Pakenham (Cranbourne No. 6); 7, Cranbourne No. 7; 8, Cranbourne No. 8; 9, Beaconsfield; 10, Langwarrin.

The Cranbourne No. 3 iron was found half a mile from the Cranbourne No. 1 iron, on Carnmallam Pre-emptive Right, some time between 1854 and 1860. It weighed 15 lb. All trace of this iron has been lost, and there is no description of its composition or structure.

The Beaconsfield iron, weighing 165 lb., was found in 1876 in a railway cutting 2 miles east of Beaconsfield railway station, parish of Pakenham (Fig. 1). The main mass of this meteorite was bought for the Krantz collection, Bonn, Germany.

The Langwarrin iron was found in 1886, in allotment 94, parish of Langwarrin, 5 miles south-east of Langwarrin railway station, by Mr. A. H. Padley, who donated it to the National Museum, Melbourne. It weighed 18 cwt. when found, but has lost weight by rusting and scaling. Its present dimensions are 36 in. x 22 in. x 20 in.

Of the later-found meteorites, only the Pakenham iron (reported as Cranbourne No. 6 by Hodge Smith, 1939) has been described (Edwards and Baker, 1941). Its weight when found was 89 lb., and its size 12 in. x 7·5 in. x 6·5 in. This iron was found in 1928 on the south side of the Princes Highway, three-quarters of a mile west of Toomuc Creek, opposite allotment 14, parish of Pakenham (Fig. 1). Prior to its detailed description, Hodge Smith (1939) incorrectly reported the weight of this meteorite as 20 lb., and stated that it was in the National Museum collection, Melbourne, but the main mass is in the Victorian Geological Survey Museum (Reg. No. 8150). It now weighs 48 lb., the loss in weight being due to rapid scaling and to the removal of portions for chemical and mineralogical examination. It has been painted with colourless duco varnish to prevent further scaling.

Of the four Cranbourne meteorites found in 1923, No. 4 and No. 5 have been reported by Hodge Smith (1939), and so-named by him. The other two are here named Cranbourne No. 7 and Cranbourne No. 8.

The Cranbourne No. 4 iron was found on the property of Mr. G. Bacon, in allotment 34, parish of Sherwood. When found it measured 39 in. x 26 in. x 20 in., and weighed approximately 1·25 tons (not 10 cwt. as reported by Hodge Smith, 1939). It was bought by the Victorian Mines Department, and is stored in the basement of the National Museum, Melbourne.

The Cranbourne No. 5, the Cranbourne No. 7 and the Cranbourne No. 8 meteorites were found close together by Mr. A. R. Croker when ploughing in his paddock in allotment 33, parish of Sherwood (Fig. 1).

The Cranbourne No. 5 (Plate IV, Fig. 1) weighs 7 cwt. (not 6 cwt. as stated by Hodge Smith, 1939), and is now housed at the Victorian Mines Department drill store. When found it measured 27 in. x 18 in. x 18 in. As a result of scaling, its present dimensions are 24 in. x 18 in. x 15 in.

The Cranbourne No. 7 iron when found weighed about 3 cwt. and measured 22 in. x 13 in. x 12 in. It was donated by the Director of the Geological Survey to the Geology Department of the University of Melbourne in May, 1941. It has scaled badly, despite painting with aeroplane cement, and is now reduced to 16 in. x 12 in. x 9 in. (May, 1943). A piece weighing 3 lb. is in the Australian Museum, Sydney; this is recorded by Hodge Smith (1939) as a piece of Cranbourne No. 5, but it is a portion of Cranbourne No. 7. Cranbourne No. 5 has not been previously cut or drilled.

The Cranbourne No. 8 iron weighed 52 lb. when unearthed. A piece was sawn off for analysis and examination at the Victorian Mines Department, and the main mass, now weighing 46 lb., is preserved in kerosene at the Geological Survey Museum, together with a small etched piece (Plate IV, Fig. 3) weighing 2 lb. Its original size was about 8·5 in x 7·5 in. x 6 in.

As shown in Fig. 1, the four irons found in 1923 all lay close to the site of the Cranbourne No. 1 iron, three of them occurring close together in one paddock. The Pakenham iron, found in 1928, lay about 10 miles to the north-west of this group, close to the site of the Beaconsfield meteorite. With the exception of the Pakenham iron, all the sites lie on a straight line joining the Langwarrin and Beaconsfield sites, which are 13 miles apart. In view of Madigan's (1940) conclusion that the smaller members of a meteorite shower lag behind the larger, it would appear that the meteorite was moving south-westwards, since the smaller masses have been found in the north-east and the larger in the south-west.

Texture and Composition

Widmanstätten Structures

The four new Cranbourne meteorites, like the earlier described irons from this district, show coarse Widmanstätten structures (Plate IV, Figs. 2 and 3), and fall into Prior's category Og, i.e., coarse octahedrites (Prior, 1920). The bands of α-iron (kamacite) are from 1 mm. to 10 mm. wide, averaging about 4 mm., and are 4 mm. to 30 mm. long, averaging 12 mm. This is typical for the four meteoritic masses.

Neumann Lines

Neumann lines were observed in the α-iron of the Cranbourne No. 7 meteorite, on surfaces that had been flattened by filing, but not on surfaces ground flat with carborundum on a rotating lap. In this respect, the Cranbourne No. 7 iron resembled the Kyancutta iron (Spencer, 1933).

Chemical Composition

Analyses were made by one of us (A.B.E.) on the metal of the Cranbourne Nos. 4, 5 and 7 irons, using freshly prepared shavings (Table 1, analyses 6, 7 and 8). The shavings from the No. 4 and No. 5 irons were obtained by drilling the respective meteorites after de-scaling their surfaces and collecting the shavings with a magnet as they broke from the drill. The shavings from the No. 7 iron were obtained during the shaping of a sawn fragment in a Selson shaping machine. Care was taken in each instance to avoid including material from nodules. In addition, three unpublished analyses of the No. 8 iron (analyses 9, 11 and 12), including one of the metal free from nodule material (Table 1, analysis No. 9), were placed at our disposal by the Director of the Victorian Geological Survey, and six published analyses are added to Table 1 for purposes of comparison.

Analyses 1 to 9 reveal marked uniformity of composition in seven of the analysed irons, but the analyses of Cranbourne No. 1 and of the Beaconsfield iron give higher figures for nickel. Coarseness of Widmanstätten structure is closely controlled by the nickel content of the iron-nickel alloy (Edwards and Hodge Smith, 1941). Widmanstätten figures developed on Cranbourne No. 1 and the Beaconsfield irons show that they, like all the other members of the group, are coarse octahedrites; had their nickel contents been those indicated in the analyses, Cranbourne No. 1 would be a fine octahedrite and the Beaconsfield iron a medium octahedrite. It is therefore almost certain that the higher nickel shown in these two analyses is due to faulty sampling, and it may safely be assumed that the nickel contents of both meteorites is of the order of 6·5 per cent.

The relative abundance of sulphur and carbon in analysis No. 10 indicates that this sample of the Cranbourne No. 8 iron included material from a pyrrhotite-graphite nodule; analysis No. 11 was made from similar material. The analysis of the scale from this meteorite (analysis No. 12) shows that during the oxidation of

Table I.
Chemical Composition of Cranbourne Meteorites.

	1	2	3	4	5	6	7	8	9	10	11	12
Fe	91·08	92·34	92·56	92·28	92·31	92·38	92·33	92·81	92·80	85·63	86·40	55·59
Ni	8·11	6·38	7·34	6·24	6·81	6·87	6·78	6·51	6·89	6·98	6·31	3·96
Co	0·50	0·75	0·48	0·58	0·54	0·49	0·53	0·55	nil.	nil.	nil.	nil.
Cu	0·01	0·02	0·02	0·06	nil.	—	—	—	nil.	nil.	nil.	nil.
P	0·11	0·19	0·26	0·17	0·37	0·21	0·19	0·24	—	0·23	—	0·31
S	—	0·18	0·04	—	nil.	nil.	nil.	nil.	—	2·21	—	0·35
C	—	—	0·05	—	—	—	—	—	—	1·94	—	0·37
Cl	—	—	0·01	—	—	pr.	pr.	pr.	—	str. tr.	—	tr.
Mn	—	—	—	—	—	—	—	—	—	sl. tr.	—	nil.
H_2O	—	—	—	—	—	—	—	—	—	2·10	—	—
Insol.	0·17	—	—	0·32	nil.	tr.	nil.	nil.	0·12	0·20	0·41	12·58
Total	99·98	99·86	100·76	99·65	100·03	99·95	99·83	100·11	99·81	99·29	93·12	73·16
Fe/Ni	11·2	14·5	12·6	14·8	13·5	13·4	13·6	14·3	13·5	12·3	13·7	14·0
Sp. Gr.	7·46	—	—	—	7·93	7·5	8·12	7·98	7·64	—	7·24	—

1. Cranbourne No. 1. Anal. W. Flight. Phil. Trans. Roy. Soc. London, 173, pp. 885-894, 1882.
2. Cranbourne No. 2. Anal. P. G. W. Bayly and A. G. Hall. Mem. Nat. Mus. Melb., No. 6, 1915.
3. Beaconsfield. Anal. O. Sjostrom. *Ibid.*, quoted by R. H. Walcott, 1915.
4. Langwarrin. Anal. P. G. W. Bayly and A. G. Hall. *Ibid.*
5. Pakenham (= Cranbourne No. 6). Anal. A. B. Edwards. Pr. R. Soc. Vict., 54 (1), n.s., pp. 7-16, 1941.
6. Cranbourne No. 4. Anal. A. B. Edwards.
7. Cranbourne No. 5. Anal. A. B. Edwards.
8. Cranbourne No. 7. Anal. A. B. Edwards.
9. Cranbourne No. 8. Sample obtained by cutting through specimen with a hack-saw. Anal. F. F. Field.
10. Cranbourne No. 8. Sample obtained by filing across the cut face of the meteorite, avoiding scale. Clearly includes material from a sulphide-graphite nodule. Anal. F. F. Field. Quoted by Hodge Smith in Aust. Mus. Mem., No. 7, p. 54, 1939.
11. Cranbourne No. 8. Sample obtained by cutting metal with a hack-saw, and including some surface scale and a nodule. Anal. F. F. Field.
12. Cranbourne No. 8. Oxidized scale. Anal. F. F. Field.

the iron there has been little or no selective leaching or migration of the nickel relative to the iron, since the ratio of Fe/Ni is practically the same as that of the fresh iron. Presumably, therefore, the nickel has entered the composition of the limonite forming the scale.

NODULES

All the Cranbourne irons are characterized by the presence in them of numerous nodules. These have been found both in the iron (Plate IV, Fig. 2) and in the limonitic scale or crust. In the Cranbourne No. 2 mass, five nodules can be observed in the polished face of the iron, which has an area of 120 x 90 mm.; the largest of these nodules measures 30 x 20 mm. One in the Langwarrin iron measures 45 x 15 mm. Those found in the Cranbourne No. 8 vary from 12·5 x 12·5 mm. to 25·5 x 19 mm. The smallest nodule found was in the Cranbourne No. 7; it measures only 1 mm. across, and consists of graphite. Another graphite nodule from the same iron measures 14 x 15 mm.; the largest nodule, a composite one, measures 25 x 15 mm. The largest nodule from the Pakenham iron (Cranbourne No. 6) measures 40 x 30 x 21 mm., and weighs 45 grams. The largest recorded occurred in the Cranbourne No. 1 iron, and is 50 mm. across.

A few of the nodules have a sub-spherical shape, and a few are ellipsoidal, irregular, or bean-shaped, but the majority approximate to a triaxial ellipsoidal shape, with average dimensions about 14 x 9 x 6 mm.

The composition of the nodules varies somewhat. A few consist solely of graphite, or troilite, or of pyrrhotite, but the majority are mixtures of graphite and pyrrhotite. A few consist of mixtures of graphite and troilite. The majority have a rim of schreibersite (Plate IV, Fig. 4), and veinlets of limonite traverse cracks in the sulphides and sometimes intervene between the sulphide-graphite cores and the phosphide rims.

According to Flight (1882), the nodules in the Cranbourne No. 1 iron consisted of troilite surrounded by thin layers of graphite and daubréelite. The nodules in the Beaconsfield and Cranbourne No. 2 irons are also reported to consist of troilite and are said to decompose to stilpnosiderite (Walcott, 1915, p. 31). It is doubtful, however, that the sulphides in these nodules were tested by etching, and in view of the preponderance of pyrrhotite over troilite in the nodules so tested from the Pakenham and the four Cranbourne irons under discussion, it seems likely that some of the substance recorded as troilite may have been pyrrhotite.

Mineral Composition

As would be expected from their chemical composition, the four irons consist essentially of α-nickel-iron (kamacite), with minor amounts of γ-nickel-iron (taenite). Associated with the iron are minor amounts of various iron-nickel phosphides. In the nodules are found other phosphides together with graphite, pyrrhotite and troilite.

The oxidized crust or scale of the meteorites consists chiefly of limonite, with residual patches of nickel-iron metal and some of the phosphides, chiefly rhabdite. In places, trevorite is associated with it, and some of the scale exudes or is encrusted with small quantities of the chlorides of iron and nickel.

Nickel-iron Alloys

The α-nickel-iron (kamacite) is iron white and isotropic, strongly magnetic and readily scratched with a needle. The standard etching reagents affect it as follows: nitric acid produces an immediate etching, but without effervescence; hydrochloric acid fumes tarnish, and the iron washes and rubs brown, but the effect is not consistent; potassium hydroxide and potassium cyanide are negative; ferric chloride instantly turns the iron brown, bringing up grain boundaries and etching grains differentially, as well as bringing up Neumann lines; mercuric chloride darkens the surface immediately. Picric acid (2 per cent. in alcohol) and bromine water darken the kamacite and bring up grain boundaries and crystal structures.

The γ-nickel-iron (taenite) occurs only as occasional groups of parallel lamellae interleaved with the kamacite plates, and as small triangular areas in the interstices of the kamacite grains. It can scarcely be distinguished from the kamacite in unetched sections, but is readily distinguished after etching with picric acid, bromine water, or 2 per cent. nitric acid in alcohol, all of which darken the kamacite but do not affect the taenite. Of the standard etching reagents, nitric and hydrochloric acids, potassium hydroxide, ferric chloride and mercuric chloride give negative results. Hydrochloric acid fumes tarnish the taenite brown, but the results are not consistent. The taenite is isotropic, strongly magnetic, and is readily scratched with a needle.

The factors controlling the disposition of the taenite lamellae in the kamacite have been discussed elsewhere (Edwards and Hodge Smith, 1941).

Iron-nickel Phosphides

Four varieties of iron-nickel phosphides have been observed in the meteorites. In appearance, etching behaviour, and manner of occurrence, these varieties are identical with those found in the Pakenham meteorite, and figured in its description (Edwards and Baker, 1941).

Two of them, schreibersite and a yellow unidentified phosphide, occur associated together, forming rims around the sulphide nodules, the schreibersite being much the more abundant. They are not found away from the nodules. The others, rhabdite and schreibersite-B, occur in the nickel-iron and do not appear in the nodules.

The schreibersite is a tin-white, brittle, hard mineral that cannot be scratched with a steel needle, occurring as the outer rim of the nodules (Plate IV, Fig. 4). It is difficult to polish on account of its brittleness, is distinctly anisotropic and strongly magnetic. On treatment with nitric acid it effervesces very slowly, the bubbles rising from the numerous cracks in the surface. With potassium hydroxide it very slowly develops a brown stain that washes brown and rubs pale brown. The action may take several minutes to develop, and sometimes appears only after several applications of the reagent. This is presumably due to the difficulty of removing films of oil from the surface, the oil having entered the many cracks during polishing.

The yellow phosphide has a creamy-yellow colour and is readily scratched with a needle. It is isotropic and does not appear to be magnetic. It is negative to all etching reagents other than mercuric chloride, which slowly stains it a purplish brown. The stain washes the same colour and is difficult to rub off, when it leaves a roughened surface.

Rhabdite occurs as small rhombs and prisms disseminated through the massive kamacite. It is much harder than the enclosing iron, and cannot be scratched with a steel needle. It is brittle, brown by contrast with the iron, distinctly anisotropic and strongly magnetic. It is negative to all standard etching reagents.

Schreibersite-B occurs as occasional large irregular areas, the shapes of which are partly controlled by the octahedral structure of the iron, but chiefly as fine vein-like areas in the interstices of the α-nickel-iron crystals. It is extremely difficult to polish on account of its brittleness and hardness. It is weakly anisotropic and generally resembles the schreibersite in appearance, but its colour is almost identical with that of the rhabdite crystals in the adjacent iron crystals. Its behaviour with etching reagents distinguishes it from both. Unlike schreibersite, it is negative to both nitric acid and potassium hydroxide, but with hydrochloric acid it effervesces slowly, the bubbles rising from the numerous cracks; and this distinguishes it from the rhabdite, which gives negative results.

The chemical composition of the four phosphides has been discussed in connection with the Pakenham meteorite (Edwards and Baker, 1941), and will not be repeated here.

Pyrrhotite and Troilite

These minerals occur only in the nodules. Both are creamy-brown in colour and strongly anisotropic, and they can be distinguished from each other only by their different etching behaviour. With nitric acid the surface of pyrrhotite is tarnished but washes clean, whereas troilite effervesces vigorously with the evolution of hydrogen sulphide. Hydrochloric acid fumes tarnish the surface of pyrrhotite but the acid does not otherwise affect it, whereas troilite effervesces vigorously with this acid and is stained brown. Of the other reagents, potassium cyanide, ferric chloride and mercuric chloride give negative results, while potassium hydroxide stains both brown.

Of these minerals pyrrhotite is more commonly present in the nodules than is troilite. The sulphides may form the whole of a nodule core, or they may be intergrown with graphite, when the proportion of graphite tends to be greater near the margin.

Graphite

Graphite was found chiefly in the nodules, but some occurs as flakes or patches in the limonitic coatings of the meteorites. In polished section it is strongly anisotropic in brownish-grey colours and is pleochroic. It is soft, brittle, inert to all etching reagents, and marks paper.

Oxidation Products

Many fragments of scale removed from the meteorites consist of unreplaced remnants of nickel-iron, sometimes several millimetres in diameter, cemented together by limonite. Such fragments have a hackly fracture, and when polished look like an iron-limonite breccia. Other pieces of the scale are sheet-like or lens-shaped, and consist essentially of limonite showing colloform banding. The limonite is studded with minute prisms and rhombs of rhabdite, indicating that the limonite has replaced the iron *in situ*. No trace of the schreibersite-B veins remains, so that presumably this mineral is destroyed by the lawrencite that the meteorites exude.

Occasionally a pinkish-brown mineral is intercalated with bands of limonite. It is isotropic and inert to etching reagents. The powder obtained with the micro-drill is distinctly magnetic, and yields positive tests for iron and nickel. The mineral is regarded, therefore, as trevorite.

The limonitic scale of the Cranbourne No. 4, No. 5 and No. 7 irons contains numerous quartz grains, and such grains have been recorded in the scale of Cranbourne No. 2 (Walcott, 1915). Both rounded and angular grains occur, imbedded in the scale to a depth of two or three inches. They apparently represent sand which has been blown against the meteorite, and adhered to it during the process of oxidation. The depth at which the quartz is found is some measure of the expansion that takes place during the oxidation and hydration of the iron.

Oxidation of the Cranbourne Irons

With the exception of the Cranbourne No. 2 iron, all these meteorites show a pronounced tendency to oxidize and scale, so that they are extremely difficult to preserve. The Cranbourne No. 1 iron in the British Museum is kept in an atmosphere of nitrogen on this account; and the Cranbourne No. 8 iron, in the Geological Survey Museum, Melbourne, is preserved in a bath of kerosene.

Oxidation is partly due to the composition of the irons, which contain insufficient nickel to enable them to resist rusting. The rapidity and depth of oxidation appears, however, to be connected with the presence of unusual amounts of chlorine (in the form of chlorides) in the interior of the meteorites. A freshly polished surface of iron, whether large or small, very soon exudes numerous droplets of ferrous chloride along the junctions of kamacite bands, along cracks, and at the junctions of nodules with the metal. One such prepared surface, 4·5 × 3·5 inches, developed strings of minute globules after standing overnight, and even when the specimen was immersed in kerosene, the globules continued to grow in size. As long as the specimen was maintained in kerosene, the liquid of the globules was prevented from attacking the iron, and when the specimen was tilted, the larger globules rolled off its surface. When, however, the surfaces of such specimens are left exposed to the atmosphere, the globules etch the polished surfaces and completely destroy the polish within a few days.

The globules are at first almost colourless and consist of ferrous chloride. On exposure to air they become yellowish and then brown as the ferrous chloride oxidizes to ferric chloride, which attacks the iron. After two or three days the ferric chloride changes to colloidal ferric oxide, which dries up to form pustules of limonite in the course of a few weeks. Sometimes a little nickel chloride develops in this way, as was noted with the Pakenham meteorite (Edwards and Baker, 1941).

It is noteworthy that the Cranbourne No. 2 iron, which does not show this tendency to rapid oxidation and scaling, is similar in chemical composition to the irons that do oxidize; but, so far as has been noticed, it has not exuded more than a few droplets of iron chloride. This mass shows flight markings, and is therefore part of the exterior of the original large meteorite of which the several masses described herein are portions.

Farrington (1901, p. 402) has suggested that gases in meteorites were partly chemically united and partly probably held in intermolecular spaces. If the chlorine (or chloride content) is a primary constituent of the Cranbourne meteorites, then presumably it was expelled (or oxidized) in the surface layers of the original meteorite at the temperature attained during flight through the atmosphere and driven under pressure into the interior of the mass where it was retained in the interspaces between the kamacite lamellae.

Another possibility is that the chlorine (or chlorides) was introduced into the meteorites as they lay, almost completely buried, in the ground. The area in which they occurred is distinctly swampy during some periods of the year, as evidenced by the records of the Victorian Mines Department, and the subsoil is saline, carrying as much as 0·1 per cent. of sodium chloride (Holmes, Leeper and Nicolls, 1940). Many of the meteorite masses lay in the subsoil for not less than 70 years, and chlorides in the surface waters might have penetrated the iron along cracks and grain boundaries.

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Description of Plate IV

Fig. 1. External surface of Cranbourne No. 5 meteorite, showing size and shape of specimen and nature of the scaled surface. (Photo.—Victorian Mines Dept.)

2. Etched surface of Cranbourne No. 7 meteorite, showing coarse Widmanstätten structure and pyrrhotite nodule surrounded by schreibersite. Dark areas in centre of photograph are portions from which metal was plucked out along octahedral structures during preparation of the flat surface. (Photo.—J. Spencer Mann.)

3. Etched surface of Cranbourne No. 8 meteorite, showing coarse octahedral structure and pronounced kamacite bands. (Photo.—Victorian Mines Dept.).

4. Nodule of pyrrhotite with irregular rim of graphite and schreibersite, embedded in limonite; from Cranbourne No. 7 meteorite. (Photo.—J. Spencer Mann.)

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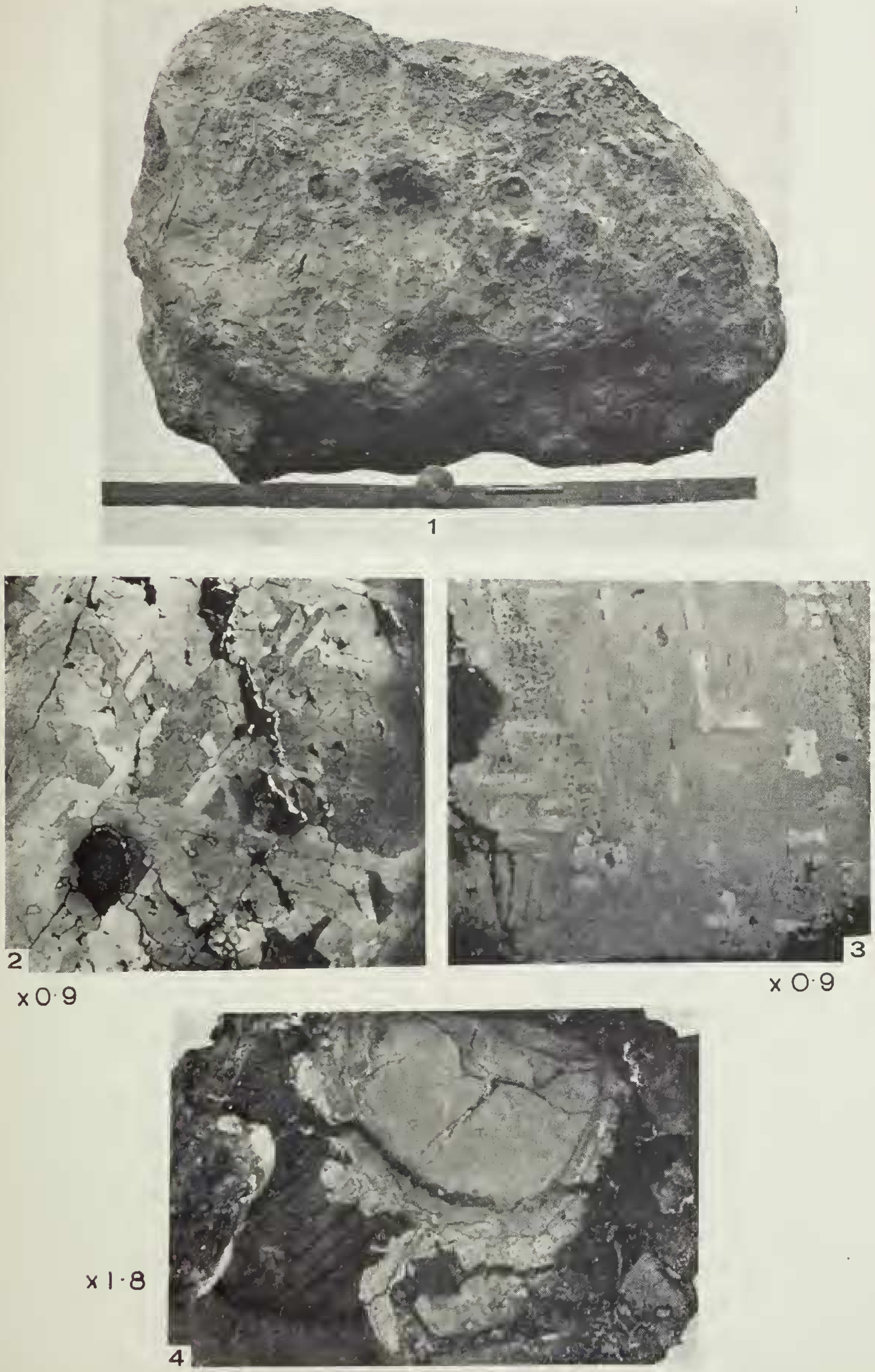

Cranbourne Meteorites